# Why
# High Performance Computing (HPC)

Pool of capital investment into state of the art hardware and software

Team(s) of system administrators and IT to maintain hardware and software

Advantages of remote computation

# Data Plague

Suppose a genomics researcher is sequencing small datasets, 1000 each 500 MB

But new datasets are in, 20x as large (10 GB), 2x as many

500 MB file may already be a burden on most machines!

# The Statistics Student

Suppose statistics student requires cross validation study

1000 runs required

Each run takes 1 hour on laptop

41 days and 16 hours of compute time!

# Idle Resources

Suppose a student with 4 core laptop is running a 2D PDE solver in serial

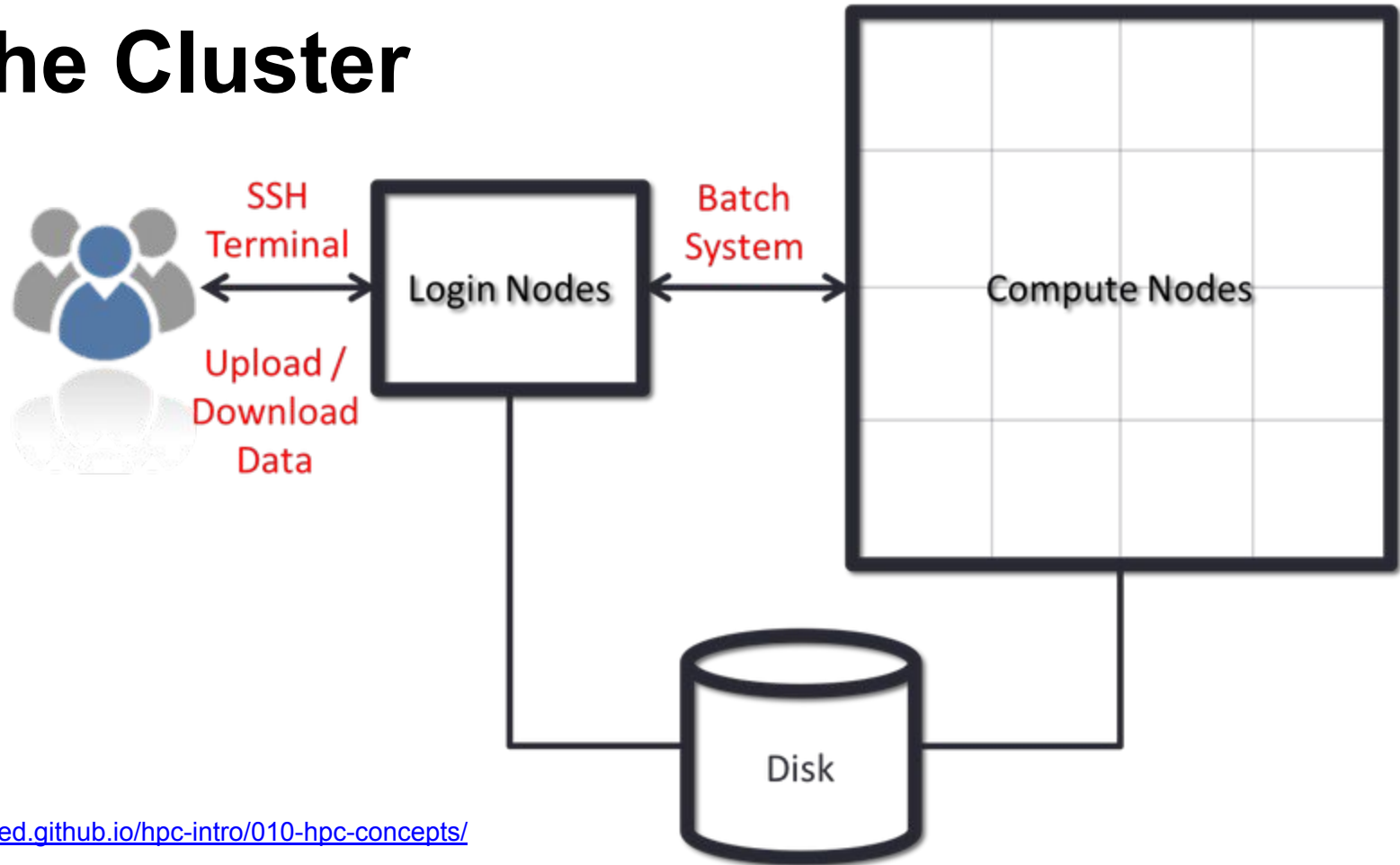Needs to go to 3D and parallel solver can be implemented

Convert laptop into quasi-permanent solver/heater?

https://epcced.github.io/hpc-intro/010-hpc-concepts/

# Considerations for HPC

- **Speed.** With many more processing cores, often with higher performance specs, than a typical laptop or desktop, HPC systems can offer significant speed up.
- **Volume.** Many HPC systems have both the processing memory (RAM) and disk storage to handle very large amounts of data.
- **Efficiency.** Many HPC systems operate a pool of resources that are drawn on by a many users. In most cases when the pool is large and diverse enough the resources on the system are used almost constantly.
- **Cost.** Bulk purchasing and government funding mean that the cost to the research community for using these systems in significantly less that it would be otherwise.
- **Convenience.** There's no need to tie up your own computer for hours when you can use someone else's instead.
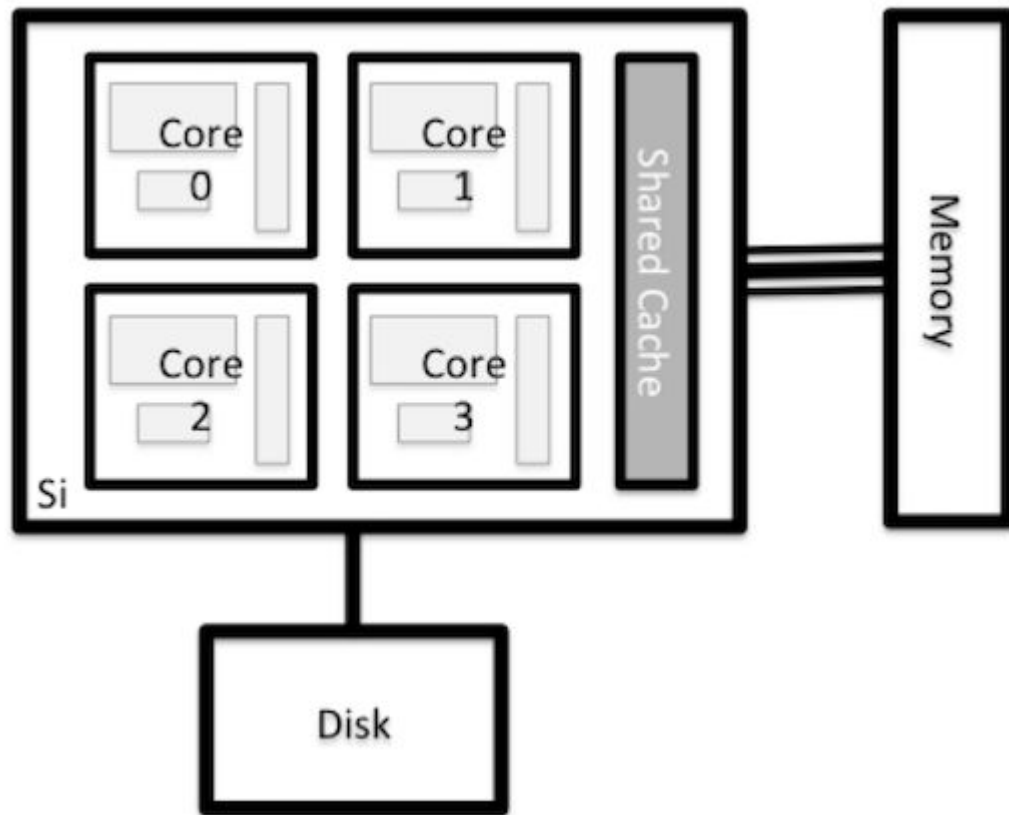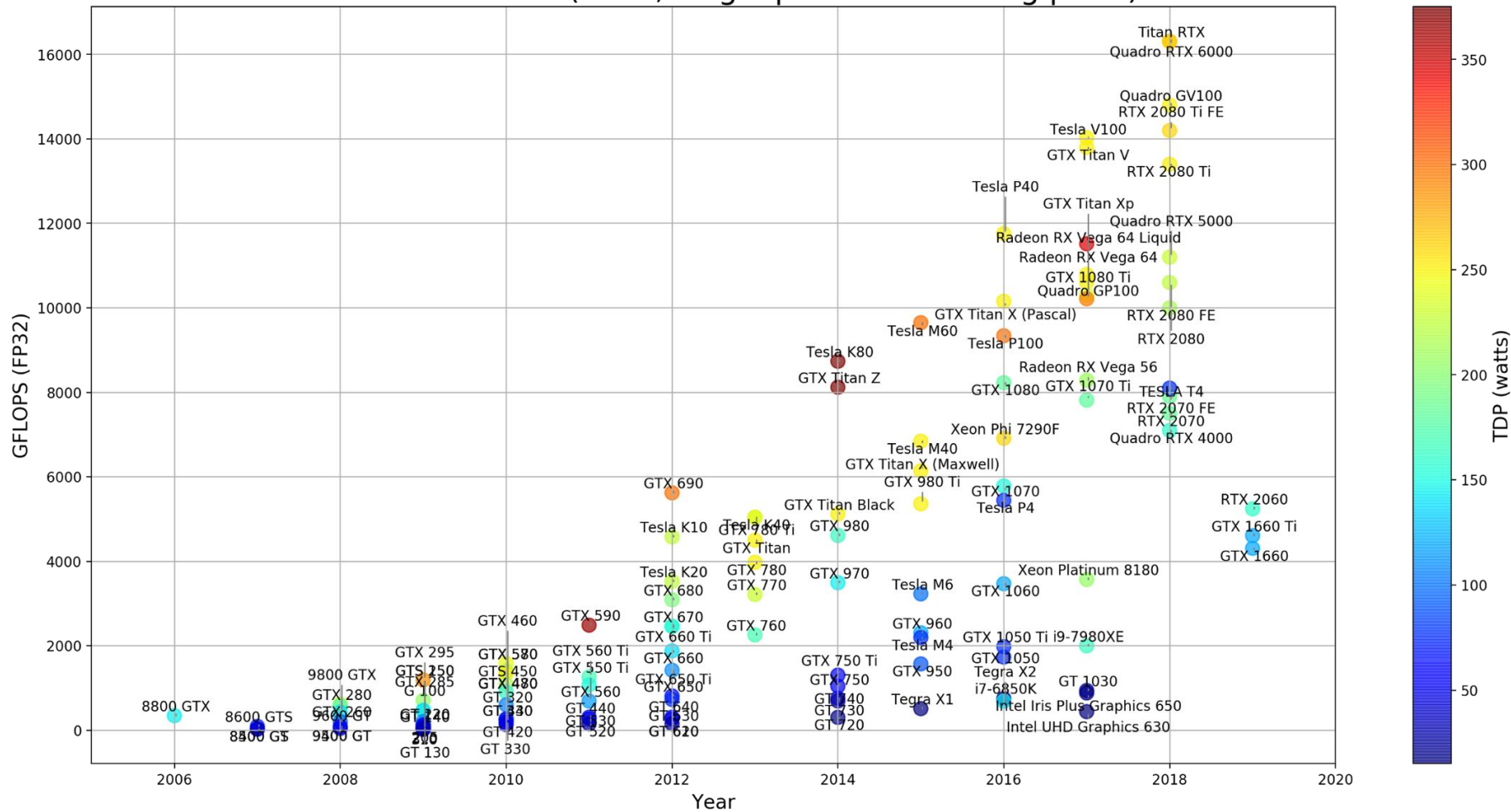
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# The Cluster



SSH Terminal

Upload / Download Data

Login Nodes

Batch System

Compute Nodes

Disk

https://epcced.github.io/hpc-intro/010-hpc-concepts/

# Compute Nodes

[Agave](https://agave) has nearly 350 compute nodes

Includes nearly 200 GPUs

GPU Performance (FP32, single precision floating point)

# Important Links

links.asu.edu/getHPC          <- create an account
links.asu.edu/docs            <- our documentation
links.asu.edu/MailingList <- our mailing list
rcstatus.asu.edu              <- system status pages
login.rc.asu.edu              <- new webapp interface to Agave

# Upcoming Workshops

Python, Data and HPC (links.asu.edu/pyHPC2)
- Feb 10, 3-4 PM Biodesign A L10-14

Python, ML and HPC (links.asu.edu/pyHPC3)
- Feb 24, 3-4 PM Biodesign A L10-14

Python, DL and HPC (links.asu.edu/pyHPC4)
- Mar 9, 3-4 PM Biodesign B Auditorium

# Conclusion

For any assistance please contact: support@hpchelp.asu.edu

Office Hours: **GWC546 1-4 PM Tuesdays and Wednesdays**

login.rc.asu.edu

# Supplemental Slides Follow

# The Scheduler

1. Transfer input datasets to the HPC system (via the login nodes)

2. Create a job submission script to perform your computation (on the login nodes)

3. Submit your job submission script to the scheduler (on the login nodes)

4. Scheduler runs your computation (on the compute nodes)

5. Analyse results from your computation (on the login or compute nodes, or transfer data for analysis elsewhere)

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- **High Performance Computing (HPC).** Computing resources that allow people to solve their problems faster or treat larger problems than they would be able to using standard computing resources (e.g. a laptop, desktop or workstation). Usually implies some sort of *parallel computing*.
- **Parallel Computing.** The use of computing resources in parallel to speed up computation or treat larger computational problems.
- **Supercomputer.** Typically used to describe a very large HPC resource such as those found on the Top500 list. Often uses the same technology as *compute clusters* but at a larger scale.
- **Compute Cluster.** Typically used to describe a smaller HPC resource than those referred to as *supercomputers*. Usually use exactly the same technology as supercomputers but on a smaller scale.
- **High Throughput Computing (HTC).** A subset of parallel computing where computing resources are used in parallel on many independent sub-tasks to increase the rate at which computation can be performed. For example, varying an input parameter (or input data) to a computation and running many copies simultaneously.
- **Cloud Computing.** Using remote computing resources *on demand*. Often associated with using public cloud computing resources provided by large internet corporations.